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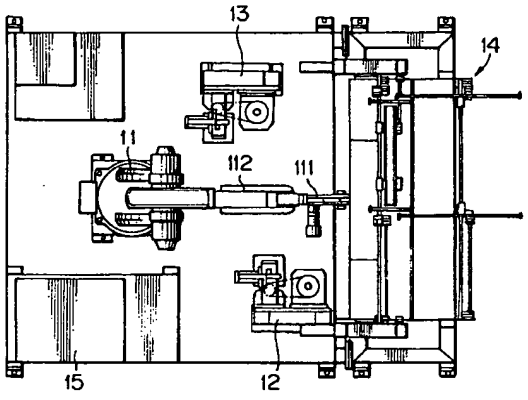
(54) Wire bending apparatus.

(57) A wire bending apparatus is described comprising a robot (11) provided with a device (111) for gripping and rotating a wire, and a suitable number of program-controlled benders (12; 13). The robot (11) grips a wire and supplies a portion of the wire to be bent to the program-controlled benders (12; 13) to bend the wire. The robot (11) is rotated through a predetermined angle while gripping the wire according to a bending direction of a next portion to be bent, after which the wire is supplied to the program-controlled bender (12; 13) to bend the wire, whereby the wire is bent into a predetermined shape.

FIG. 4



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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a wire bending apparatus.

2. Description of the Related Art

At present, there are various wire bending machines such as an NC bender, an exclusive-use machine, and so on.

Fig. 1 shows one example of an NC bender, in which one end of a work 1 (a wire) is held by a work chuck 2, the work chuck 2 is advanced (moved leftward in Fig. 1) to set the work 1 to a bending segment 3, a fixed clamp 4 and a movable clamp 5 are actuated, and the movable clamp 5 is rotated in a direction indicated by an arrow to bend the work 1. These operations are subjected to NC control. A bending angle and a bending direction are set by a rotating amount of the movable clamp and a rotation of the work chuck 2, respectively.

Figs. 3(a) and 3(b) show an exclusive-use apparatus for bending a work 1 into a crank shape as one example shown in Fig. 2. Works 1 are taken out by carrier loaders 6 and successively transferred to exclusive-use benders 7 for bending thereof.

SUMMARY OF THE INVENTION

An NC bender used at present for production of a variety of kinds and in a small quantity is equipment exclusive use for bending, which cannot carry out bending of opposite ends and which cannot automatically supply a set of works without intermediary of separate equipment, thus requiring an operator. Since separate equipment (a loader and an unloader) are required, an initial cost increases. Further, equipment of set and offset, a layout space and a swinging space for work become large, thus requiring an equipment space.

On the other hand, in the exclusive use machine, the number of processes increases, the initial cost of equipment is high, a space becomes large, and control of attitude of work becomes complicated. In addition, for adjustment of a bending amount, each exclusive use bender 7 has to be readjusted. This takes time and the preparation time increases.

It is an object of the present invention to provide a wire bending apparatus which is free from these problems noted above.

The present invention has been proposed in order to achieve the aforesaid object. The apparatus of the present invention comprises a robot provided with a robot hand having a device which grips and rotate a wire, and one or two program-controlled benders. In the apparatus of the present invention, reduction in space for equipment and safety measures has been taken into consideration, and products are continuously processed without releasing a work. Furthermore, the best use of features of a multi-articulated robot is made so that separate units (a secondary working unit, a tertiary working unit, etc.) are arranged in the periphery thereof whereby multi-purpose products can be worked and short of labor is overcome.

Since in the present invention, the robot is used, operations from work-set to offset can be automatically carried out. Since the robot hand has a function for rotating a wire, it can execute bending in a suitable direction, at a suitable angle and of suitable dimension as well as the function of the robot itself. Even in the case where the bending state is complicated, various kinds of wire bended products can be manufactured by changing a program.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a conventional NC bender.

Fig. 2 is a view showing an example of a bended work.

Fig. 3 is a view showing a schematic structure of a conventional exclusive use machine.

Fig. 4 is a plan view showing the whole structure of an embodiment according to the present invention.

Fig. 5 is a side view with a part of Fig. 4 omitted.

Fig. 6 is an enlarged plan view of a robot hand.

Fig. 7 is a left side view of Fig. 6.

Fig. 8 is a lower end view of Fig. 7.

Fig. 9 is a plan view of a program-controlled bender in the embodiment.

Fig. 10 is a side view with a part of Fig. 9 omitted.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 4 is a schematic plan view showing the structure of an embodiment according to the present invention, and Fig. 5 is a side view thereof. Reference numeral 11 designates a multi-articulated robot; 12, 13 program-controlled benders; 14 a work chuter; and 15 a control panel.

For better understanding, Fig. 5 omits one program-controlled bender 13.

Fig. 6 is an enlarged plan view of a robot hand 111, Fig. 7 is a left side view thereof, and Fig. 8 is an end view as viewed from the bottom of Fig. 7.

The robot hand 111 can be risen and fallen with respect to a robot arm 112 and rotated, similarly to a conventional robot hand, and has a function to grip and rotate a wire X.

More specifically, a rotary body 116 provided with a wire inserting groove 113 and wire gripping devices 114 and 115 on both sides thereof is provided at the end of the robot hand 111, said rotary body 116 being rotated by a control motor 117 through a first gear 118, a second gear 119 and a third gear 120. The wire gripping devices 114 and 115 are designed so that a movable clamp 122 is elastically pressed against a fixed clamp 123 by a coil spring 121. A wire guide groove 124 and air cylinders 125 and 126 for pushing back the movable clamp 122 against the coil spring 121 are provided at the end of the robot hand 111. When a wire is gripped and when a wire is released, the air cylinders 125 and 126 are actuated, and when a wire is bended, a wire X is gripped by the movable clamp 122 and the fixed clamp 123 by virtue of the force of the coil spring 121.

Accordingly, the wire X can be rotated by a suitable angle of rotation by controlling the control motor 117, and the wire X can be gripped or released by controlling the air cylinders 125 and 126.

Fig. 9 is an enlarged plan view of a program-controlled bender 12, and Fig. 10 is a side view with a part cutaway. Reference numeral 16 designates a fixed clamp jig; 17 a movable clamp jig driven by a hydraulic cylinder 18; and 19 a rotary segment (a bending jig) provided with two bending pins 21 and 22 driven by the control motor 20, which is a single preparation type jig adjusted to products to be processed. One bending pin 21 is provided at a rotational center position of the rotary body 19.

Accordingly, the wire X is set between the bending pins 21 and 22, the wire X is gripped by the movable clamp jig 17 driven by the hydraulic cylinder 18 and the fixed clamp jig 16, and thereafter the rotary segment 19 is rotated by the control servo motor 20 to thereby bend the wire X.

A bending angle can be suitably decided by the control of the control servo motor 20.

In the wire bending apparatus according to the present invention, a unworked wire X (a work) is placed on an inlet portion A of a wire chuter 14, and the robot 11 is program-controlled so that the wire X is picked up by the robot hand 111, the end of the wire X is moved to the program-controlled benders 12 and 13 on both sides of the robot 11 and the wire X is rotated to the mounting position of the program-controlled benders 12 and 13 by the wire moving function of the robot 11 and the rotating function of the robot hand 111. In this manner, the complicated bending working is executed.

After completion of the bending working, the robot 11 drops the wire X on an outlet portion B of the wire chuter 14 to complete the bending work.

While in this embodiment, two benders are provided so that both ends of the wire are worked by separate benders, it is to be noted that since the robot hand 111 is risen and fallen with resepct to the arm and rotated, similar bending working can be carried out even by one bender.

While in the aforementioned embodiments, the case has been described in which the robot hand 111 is mounted on the multi-articulated robot, it is obvious that similar bending working is carried out even if the other type robot is mounted on the robot hand 111.

According to the present invention, bending of various kinds of shapes can be carried out merely by changing a program. Further, the apparatus can be installed in a space which is far narrower than that of the conventional exclusive use machine. Moreover, accessory equipment such as a loader and an unloader are not required. thus greatly improving an economical value. Furthermore, less swinging area of products is required. In addition, the safety effect increases as compared with the conventional NC bender and the exclusive use machine.

Moreover, there is the merit in that a specialist (a high class technician) is not required for operation work of equipment. Furthermore, there is provided an effect even for a simple pipe bending by improvement of a bending segment and a clamping jig.

Claims

1. A wire bending apparatus comprising a robot having a robot hand provided with a device for gripping and rotating a wire, and a suitable number of program-controlled benders.

2. A wire bending apparatus according to claim 1, wherein said robot is a multi-articulated robot.

3. A wire bending apparatus according to claim 1 or 2, wherein said device for gripping and rotating a wire is composed of a rotary body provided with a wire inserting groove and wire gripping devices on both sides, and a control motor for driving said rotary body, and said wire gripping device is composed of a fixed clamp and a movable clamp normally in contact by means of a spring, and means for moving the movable clamp away from the fixed clamp against the spring.

FIG. 1 PRIOR ART

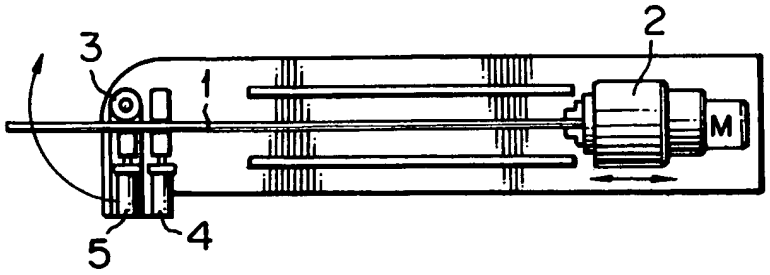


FIG. 2

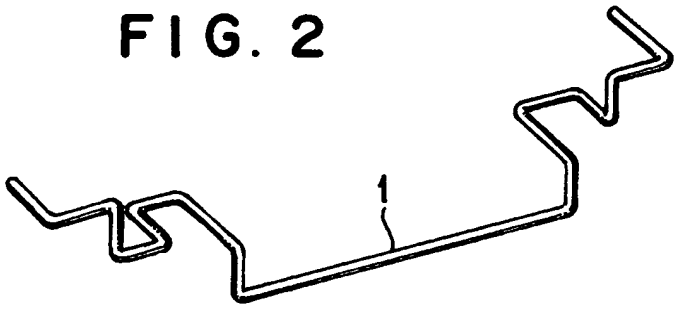
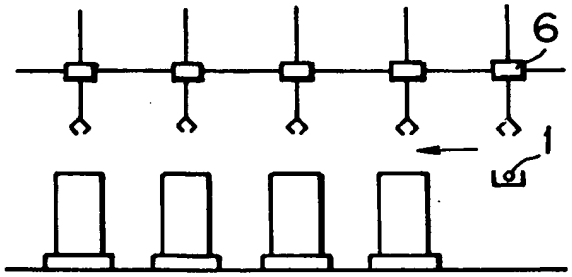


FIG. 3 PRIOR ART

(a)



(b)

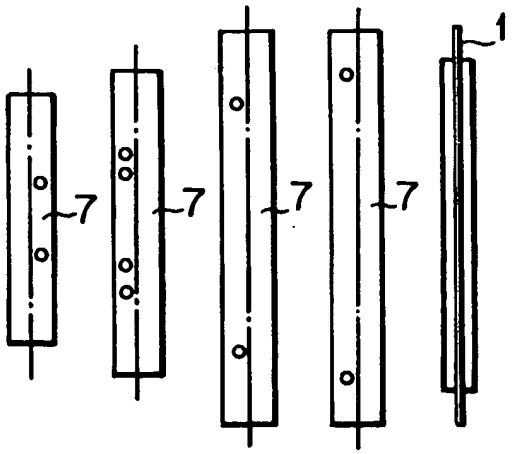


FIG. 4

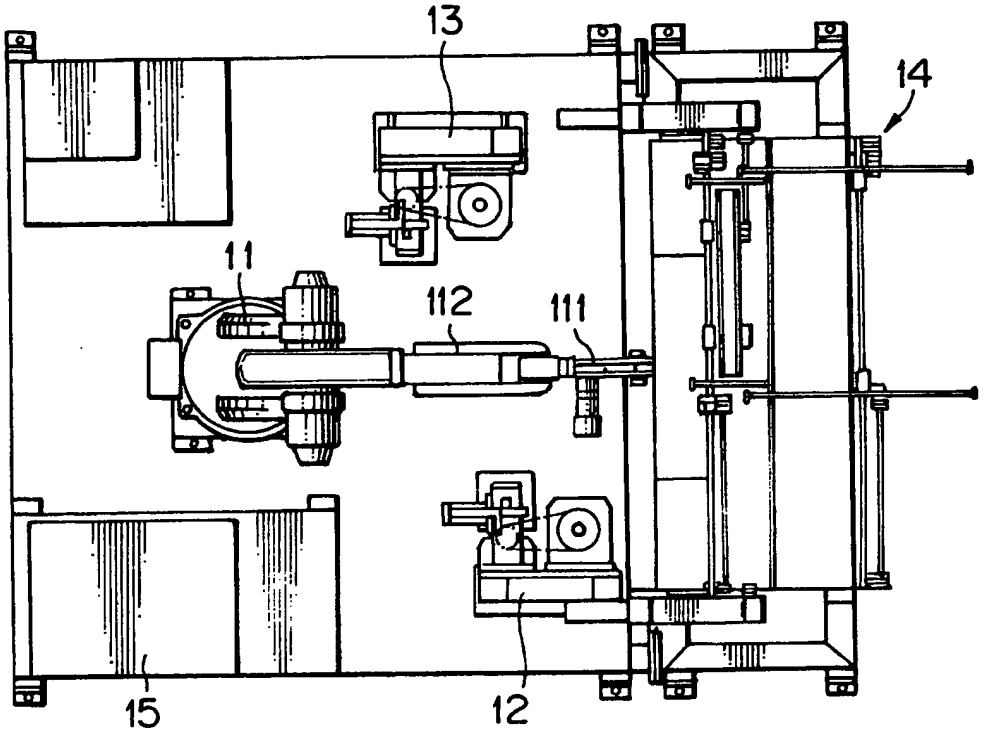


FIG. 5

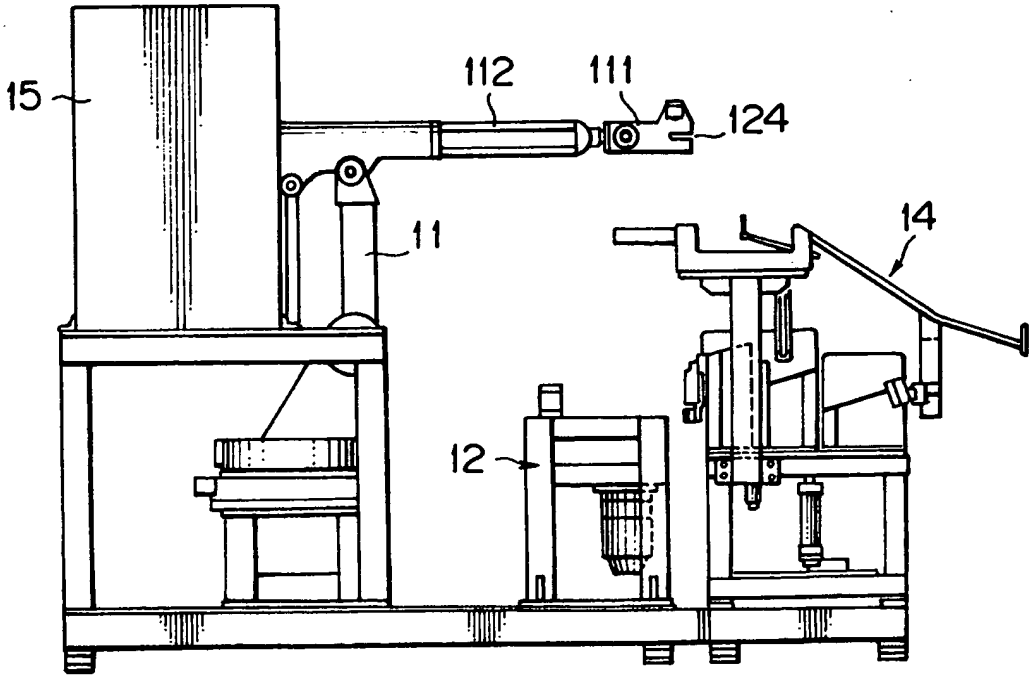


FIG. 6

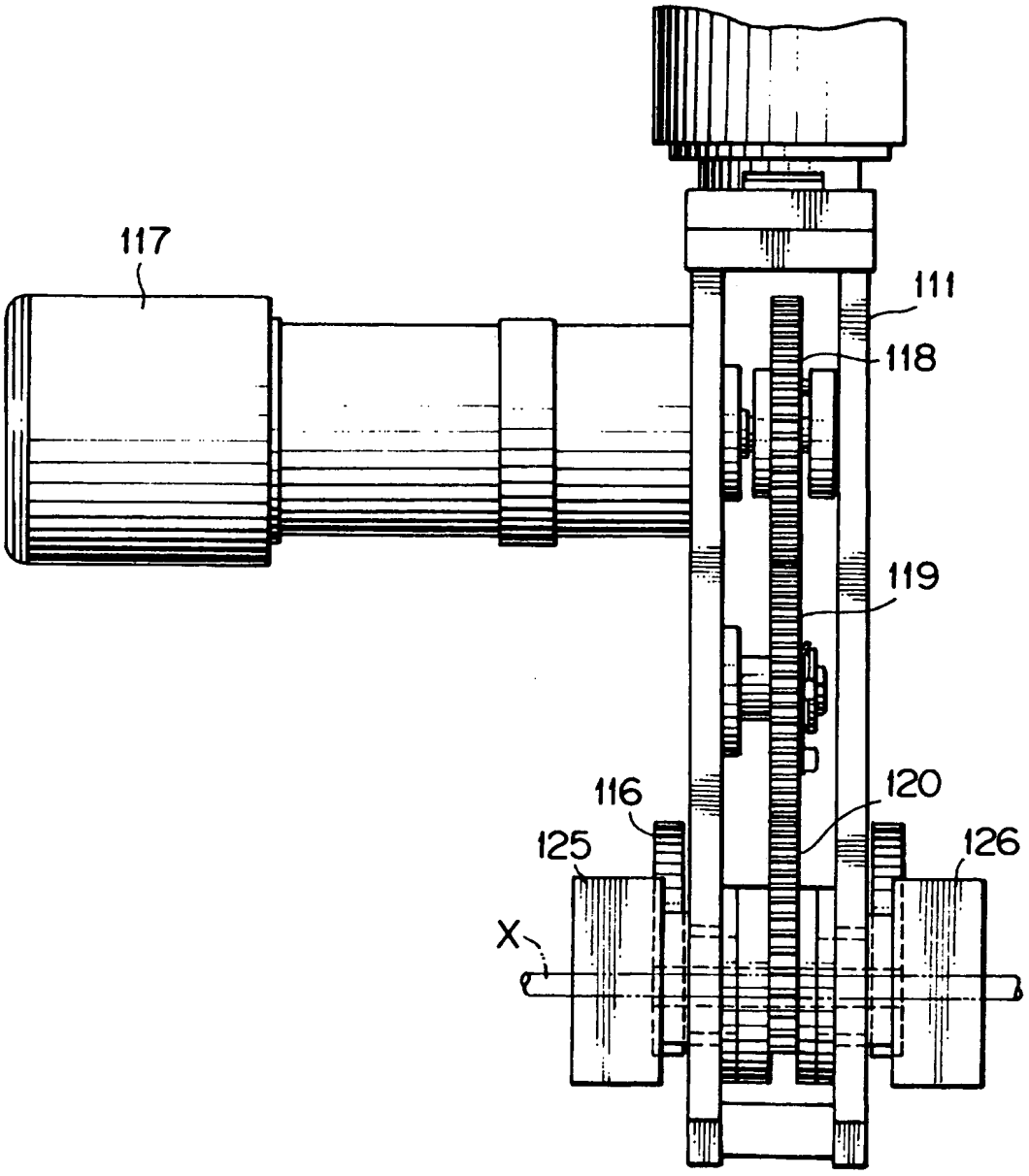
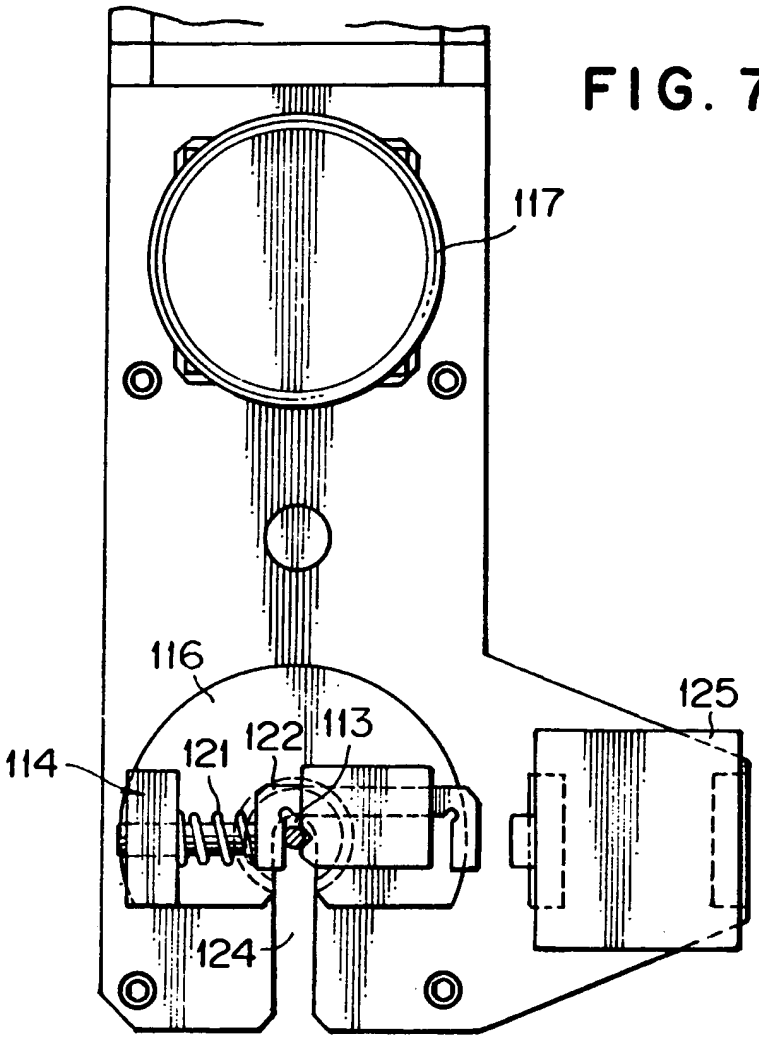


FIG. 7


117
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121
122
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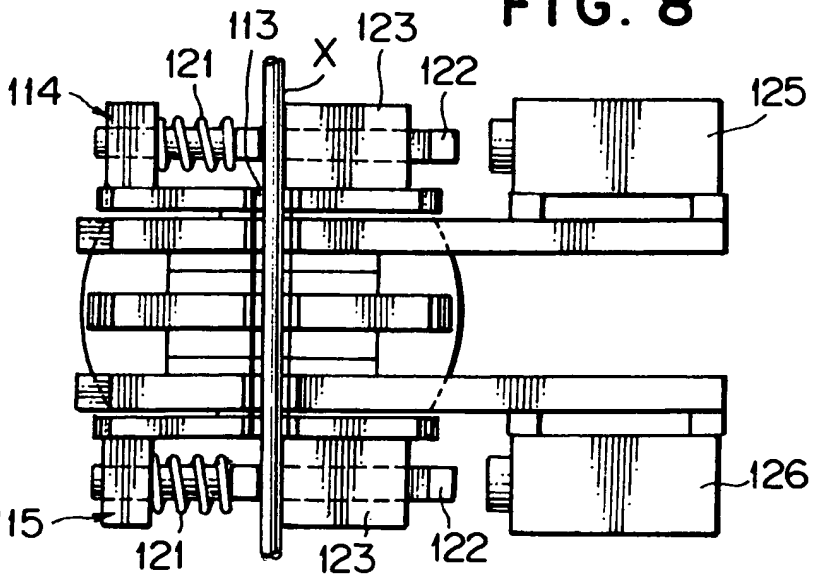
FIG. 8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122

FIG. 9

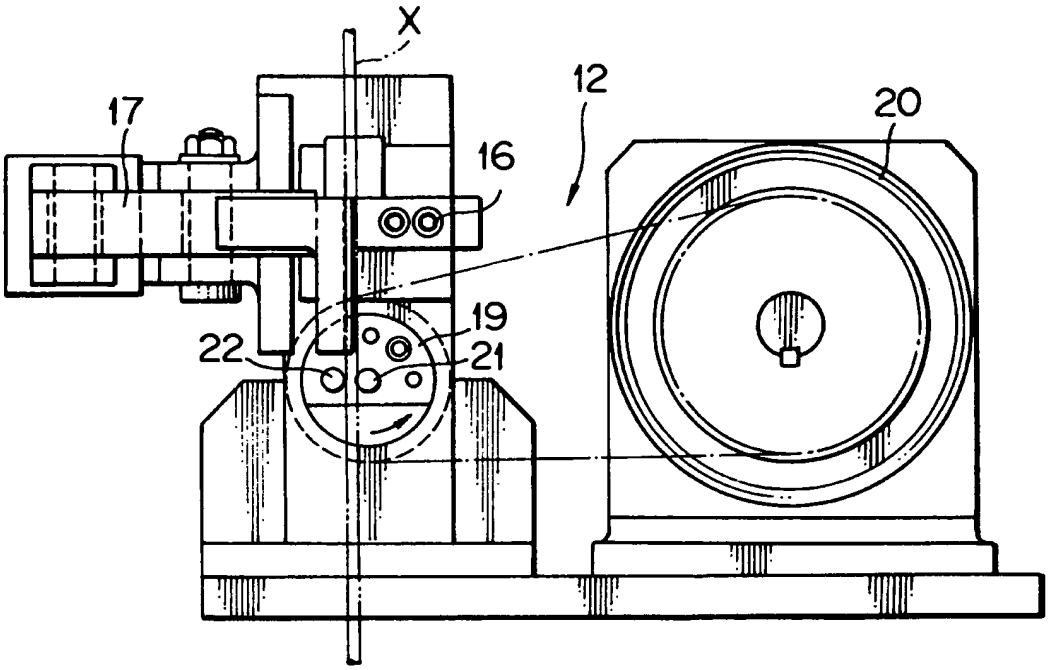
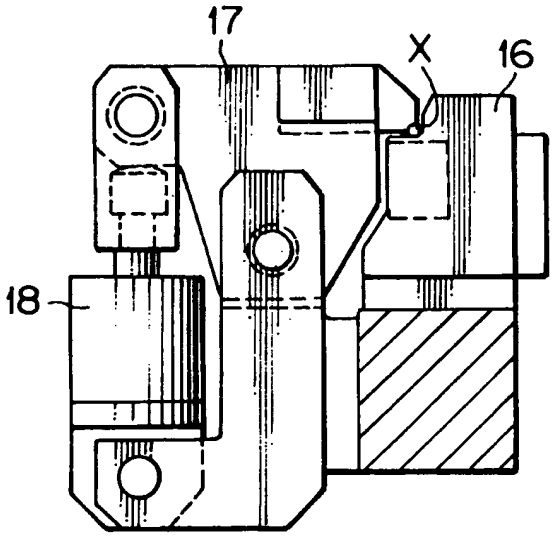


FIG. 10



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EUROPEAN SEARCH REPORT

Application Number
EP 92 11 9451

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-A-3 236 663 (TOYOTA JIDOSHA K.K.) * page 9, line 17 - line 20 * * page 13, line 26 - page 14, line 12; figures 6-8 *	1	B21F1/00
A	EP-A-0 445 044 (EATON LEONARD PICOT S.A.) * column 4, line 37 - line 55; claim 1; figures *	1-3	
A	EP-A-0 141 745 (AUTOCOUSSIN) * abstract; figures 1,2,5,6 *	1,3	
A	GB-A-2 230 215 (LANGBOW LTD.) * abstract; figures 1,2 *	1,3	
A	US-A-3 245 433 (TAYLOR) * column 3, line 75 - column 4, line 53; figures 2-8 *	1,3	
A	US-A-4 967 472 (EBIHARA ET AL) * figures 1,5 *	1,3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B21F
B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 APRIL 1993	BARROW J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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